THE **BIODIVERSITY** CONSULTANCY

Briefing note

Hydropower: applying the mitigation hierarchy to manage biodiversity risks

Business implications and relevance

- Hydropower is a key part of the low-carbon energy mix. Many projects are under development and huge potential remains to be developed worldwide.

- The risk to biodiversity posed by hydropower projects is attracting increasing attention from lenders and governments.

Biodiversity impacts of hydropower projects

There are significant advantages to hydropower: it is a renewable energy source, has low greenhouse gas emissions and can generate cheap electricity. Most importantly, it is possible to store energy with guaranteed delivery of electricity to the grid almost immediately. When associated with dams and reservoirs, hydropower offers additional, usually positive services, such as flood control and the capacity to manage water levels for navigation and irrigation.

However, biodiversity impacts can be significant and adverse. These may include terrestrial and aquatic habitat loss under reservoirs, degradation of habitats downstream, and fragmentation of rivers due to the barrier effect of dams. For some species, the effects may be severe, even leading to extirpation from the entire watershed.

Assessing biodiversity risks at very early stages in project planning can help developers choose designs that minimise impacts. In turn, this can help keep projects on track, maintain good stakeholder relations and provide reassurance to lenders.

The **Kihansi Spray Toad** lives in an area of less than two hectares around the Kihansi Falls in eastern Tanzania. Its survival in the soaked vegetation depended entirely on spray from the falls. Hydropower development cut off 90% of the original water flow to the Kihansi Gorge, reducing the spray, altering vegetation composition and contributing to a population crash. Mitigation has included an artificial sprinkler system to mimic the waterfall mist, and a captive breeding programme for re-introduction into the wild.
More information: thegef.org, iucnredlist.org. Image © thegef.org.

At a glance

As an energy source, hydropower has clear advantages but projects can have significant adverse impacts on biodiversity.

The **mitigation hierarchy** is an effective tool to ensure alignment with lender and government good practice and to safeguard biodiversity.

Measures to mitigate impacts on biodiversity are most effective when explored during the **early stages of project development**, especially at the site selection and planning phase.

In some cases, it may even be possible for hydropower projects to leave no overall impact on biodiversity (no net loss).

Achieving no net loss will be challenging, but is most feasible for projects which can meet power and flow regulation objectives with limited habitat loss and low downstream impacts.

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Good practice for industrial-scale development

The potential impact of energy projects on biodiversity is a significant business risk – and one that is attracting ever increasing attention from lenders[1] and governments.

Good practice for managing such risk includes implementation of the mitigation hierarchy to ensure no net loss (NNL) and/or achieving a net gain of priority biodiversity (e.g. IFC PS6, see TBC 2012). Aligning with such biodiversity requirements can help developers access finance and permits. Recent examples of hydropower projects aligning with best practice include Reventazón in Costa Rica and Chaglla in Peru.

Measures to mitigate impacts on biodiversity are most effective when explored as part of due diligence investigations or during the very early stages of project development, especially at the site selection and planning phase and ideally at the basin level. It is best done through an upfront risk screening to identify project options with the least significant biodiversity risks, where NNL is most likely to be feasible (Figure 1). Optimised solutions will seek to balance low cost of energy, high total energy output, high guaranteed power and low biodiversity impact (upstream and downstream).

IFC PS6 defines criteria and thresholds that guide the identification of priority biodiversity that are applicable to due diligence for hydropower projects. These criteria and thresholds have been developed with broad stakeholder input and so the approach is valuable even for projects that are not seeking IFC funding.

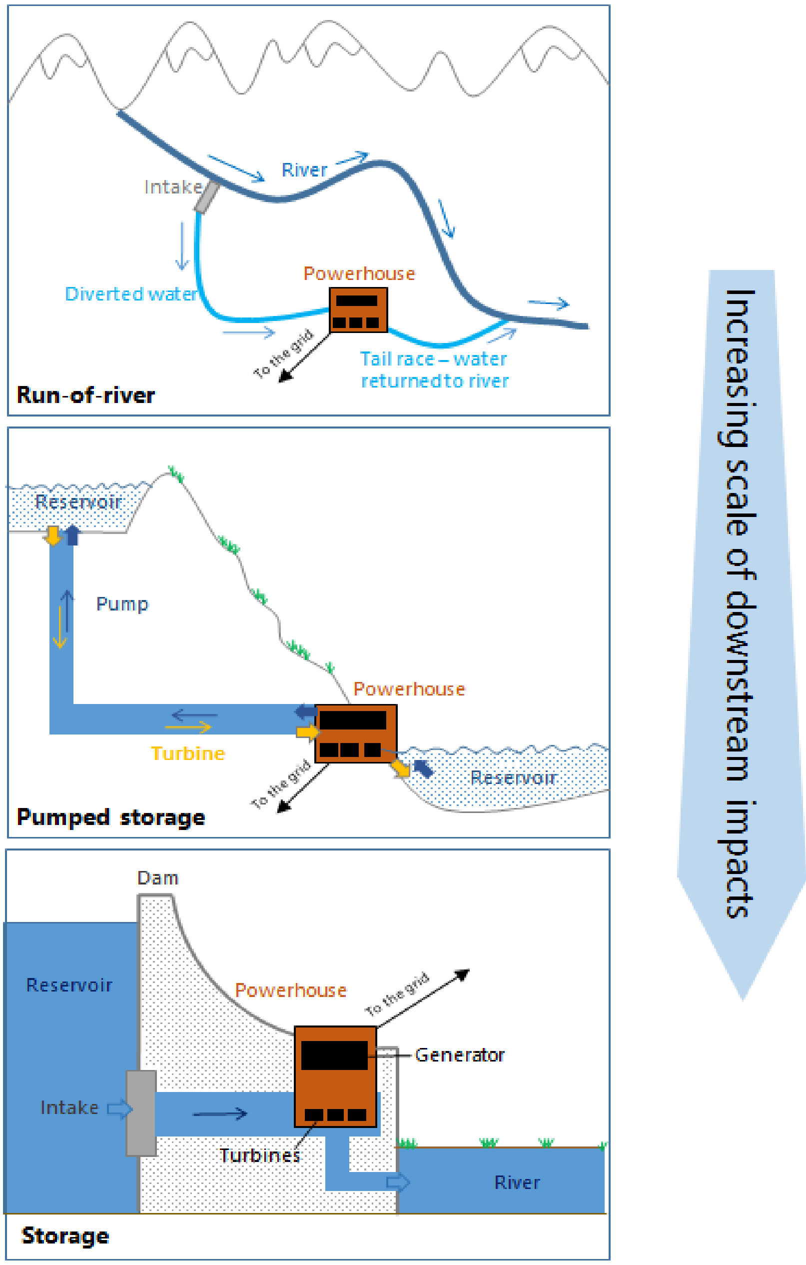

Figure 1: The three main types of hydropower scheme, with increasing adverse biodiversity impact (i.e. storage projects have the greatest potential for downstream impact).

1. E.g.: Development banks like International Finance Corporation, Inter-American Development Bank, African Development Bank or Asian Development Bank, and Financial Institutions that have adopted the Equator Principles.

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Applying the mitigation hierarchy to a hydropower project

A concise description of the mitigation hierarchy has been prepared by TBC and is available on our website. It is a tool to guide projects towards limiting biodiversity impacts as far as possible. There are four stages: Avoidance, Minimisation, Rehabilitation/Restoration and Offsetting (Figure 2).

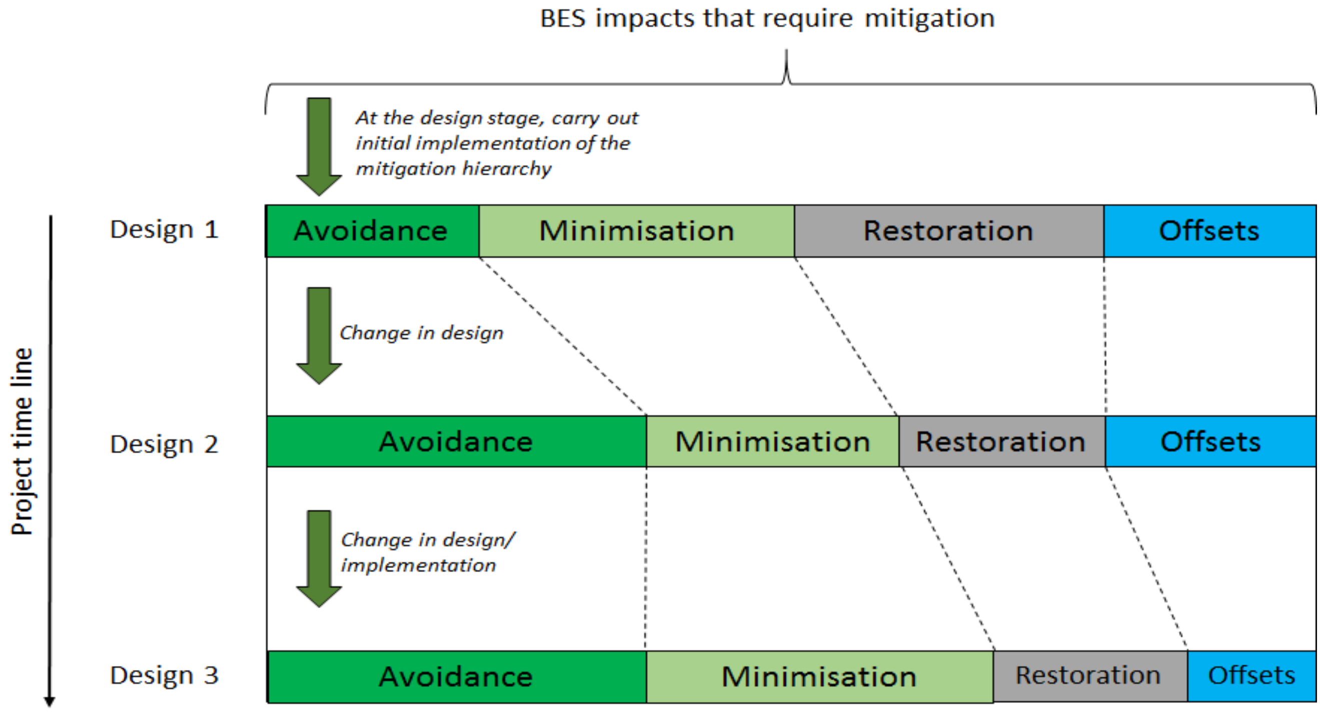

Figure 2: Sequential application of the mitigation hierarchy helps a project identify the optimum mix of biodiversity mitigation. It is most effective at minimising impacts and reducing costs when first applied at very early project stages.

Avoidance and minimisation

These are preventative stages. They are the most reliable and often the most cost-effective. The best time to implement avoidance is in the early stages of strategic project development, such as during national (watershed-level) hydropower planning. The aim is to choose project sites and designs with the least biodiversity impact, reducing the need to implement measures at the later stages of the mitigation hierarchy.

Once the project site is selected, there are still significant opportunities to avoid and minimise impacts on biodiversity at the feasibility stage when key design parameters are refined. Many of these opportunities are general rather than specific to a biodiversity feature, and usually provide wider benefits at the ecosystem/landscape scale. Table 1 overleaf shows some examples of avoidance and minimisation.

This fish ladder on the Lower Monumental dam on the Colombia River is designed to minimise the impact on migratory fish.

Photograph courtesy of salmonrecovery.gov

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Table 1: Examples of avoidance and minimisation measures for some common hydropower project

Commonly identified impacts for mitigation	Example mitigation measure
Habitat loss and degradation under reservoir	***Avoid*** by quarrying within the extent of the planned reservoir, where possible ***Minimise*** by optimising dam height and flow regulation to balance energy output with habitat loss and degradation
Loss of biodiversity due to reservoir flooding	***Minimise*** by searching the area prior to flooding and exploring the potential for translocating priority species to other areas where numbers are low and where prior threats have been reduced
Downstream hydrological and ecological change	***Minimise*** by ensuring there no periods of zero flow during construction or operation: even a half-day of zero flow can wipe out endemic species with small ranges ***Minimise*** by considering appropriate environmental flows in design, to maintain or mimic important natural patterns (e.g. natural flow seasonality and peak discharges to sustain downstream wetlands) ***Minimise*** downstream flow fluctuations by incorporating a re-regulation reservoir ***Minimise*** effects of reduced sedimentation through silt-trap fences
Barrier effect to fish	***Minimise*** by installing appropriately designed fish passes to permit migration to continue; select fish-friendly turbines to avoid mortality and allow fish passage.

Rehabilitation/restoration measures

These measures are applied after feasible options for avoidance and minimisation have been exhausted. Options for restoration are usually limited because dams are rarely decommissioned. However, opportunities do exist for the restoration of temporary work areas (e.g. quarries and access roads), and for optimising the biodiversity value of the new reservoir habitat. For example, a shallow reservoir design (or one with shallow margins), with limited drawdowns, can encourage the development of productive wetland habitats, or artificial islands can be created to attract biodiversity. Such restoration/rehabilitation measures are good practice and can be popular with local stakeholders.

Offsetting

Offsets are a last resort designed to compensate for significant adverse residual impacts that remain after all feasible avoidance, minimisation and restoration has been carried out. To meet international best practice standards, most hydropower projects will need to offset residual impacts on priority biodiversity. A concise summary of offsets is available on TBC's website.

Although it is the final stage in the mitigation hierarchy, any requirement for offsets should be identified in the early project planning stages through risk screening. There are two main types of offset: 'restoration offsets' and 'averted loss offsets' (Table 2).

River offsets differ from terrestrial offsets and will need specific methods to assess losses and gains of biodiversity. They can be complex to design because:

- impacts may extend over very long distances, potentially from the source to beyond the river mouth;
- a river is part of a wider network – the watershed – that interacts directly with other ecosystems, sometimes far from the river itself;
- a watershed may have a unique species composition, making it challenging to find an ecologically equivalent offset site elsewhere;
- watersheds frequently also provide significant ecosystem service values so integrating social and biodiversity considerations can be challenging.

In all cases, early planning can increase the likelihood of identifying feasible offsets that are acceptable to stakeholders.

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Table 2: Examples of offsetting for a hydropower project

Offset type	Example
Averted loss	Achieved by withdrawal/preclusion of potential or planned development in high biodiversity value/ impact watersheds. This may be challenging to achieve, but is an effective offset measure to explore with stakeholders. Reventazón in Costa Rica is an example of an averted loss offset for natural river habitat.
Restoration	Measures to reduce erosion in degraded watersheds can offer significant opportunities to improve water quality with the additional benefit of reducing siltation in reservoirs.

Is no net loss feasible for a hydropower project?

Given the complexity of aquatic ecosystems, the likelihood of landscape-level effects and the potential for significant residual impacts on biodiversity, only a limited subset of hydropower projects is likely to achieve NNL of biodiversity. Meaningful stakeholder engagement will be crucial to ensure that priorities, goals and management objectives are understood and agreed.

Conceptually, NNL is likely to be most technically and financially feasible for projects with a high ratio of guaranteed power capacity to reservoir area *and* a high ratio of annual river inflow to regulated reservoir capacity (Figure 3). In practice, NNL is likely to be more feasible for run-of-river designs and less feasible for storage projects, as per Figure 1.

These simple metrics do not reflect the complexity of the technological or biodiversity context, but nonetheless are a useful early and high-level indicator of the potential 'offsetability' of a hydropower project. These or similar metrics are valuable to identify projects with the least potential for biodiversity impact, and to develop an appreciation of the likely offset feasibility as early as possible in project planning.

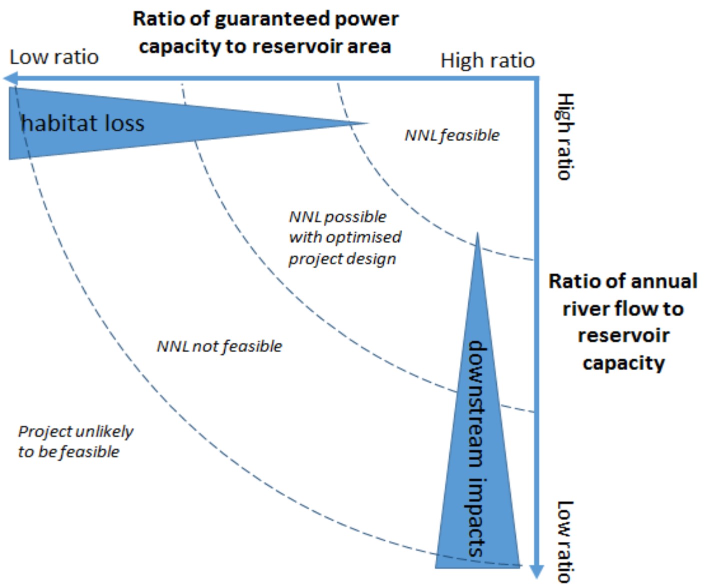

Figure 3: No net loss is most likely to be feasible for projects which can meet power and flow regulation objectives with limited habitat loss and low downstream impacts.

The Biodiversity Consultancy works together with industry leading clients to achieve an ecologically sustainable basis for development by tackling complex biodiversity challenges and by supporting positive conservation outcomes. Contact us to find out how we can help you to:

- Identify and avoid risks before they occur
- Deliver your projects on time and at cost
- Turn environmental challenges into opportunities
- Demonstrate shared value to stakeholders
- Build a positive brand and sustainable business.

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